

Recent Results on B Physics at DØ

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Dzero Collaboration

*Les Rencontres de Physique
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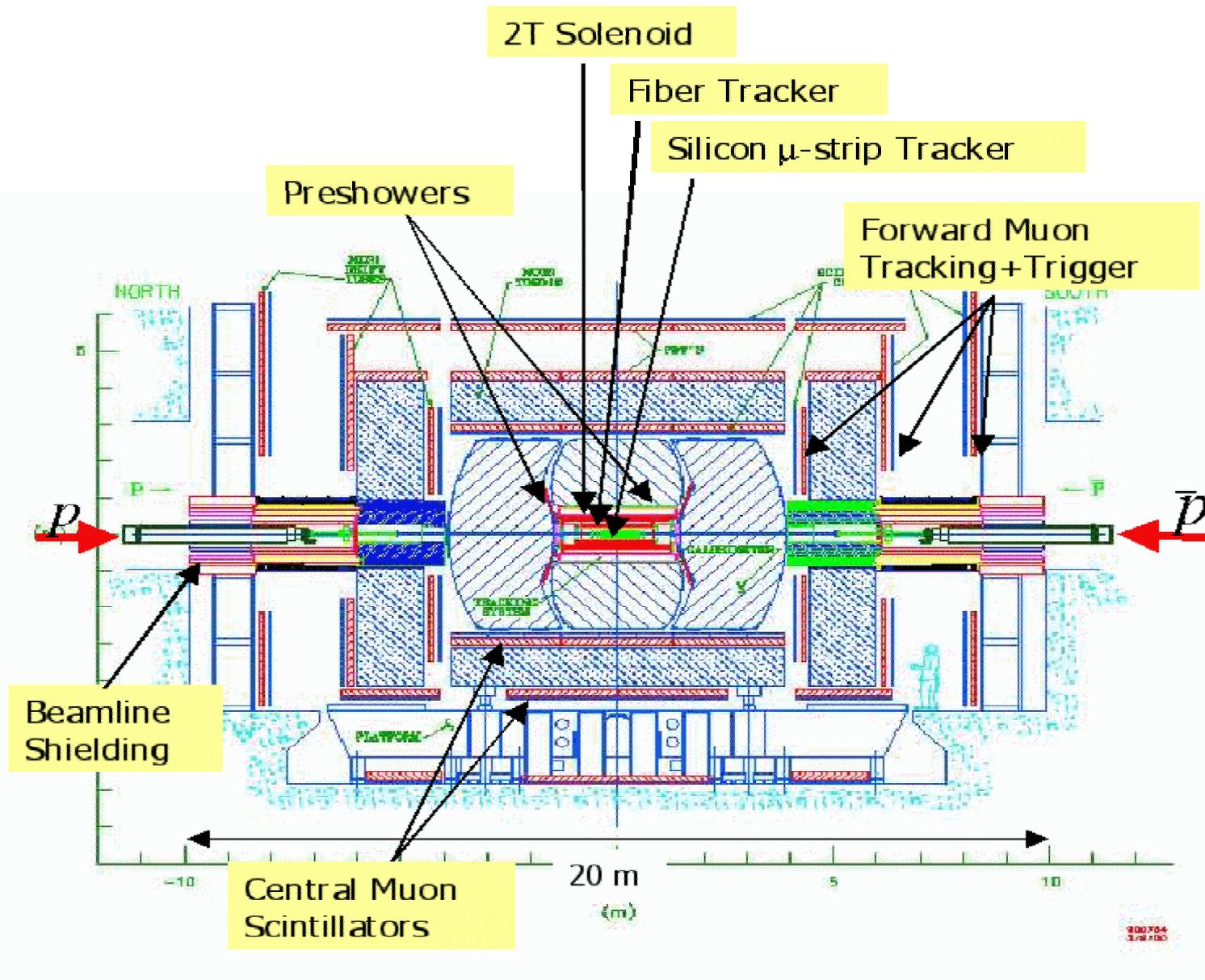


DØ B Physics Program

- B_s^0 mixing: $B_s \rightarrow D_s \mid X$, $B_s \rightarrow D_s(n\pi)$
- B Lifetimes
 - Average B lifetime: $b \rightarrow J/\psi X$
 - Λ_b lifetime: $\Lambda_b \rightarrow J/\psi \Lambda^0$
 - B_s^0 lifetime and width: $B_s^0 \rightarrow J/\psi \phi$
- CP violation in B_d^0 & B_s^0
- Rare decays, cross sections
- Ingredients for a Time-dependent B Physics program
 - Reconstruct final states
 - Reconstruct proper time distribution
 - Tag the flavor of the b at production



The Run II DØ Detector





B jet Cross Section



Measured in Run1: 2-3 times higher than predictions

•Strategy:

Measure μ +jet cross-section
Extract b-content using P_T^{Rel}

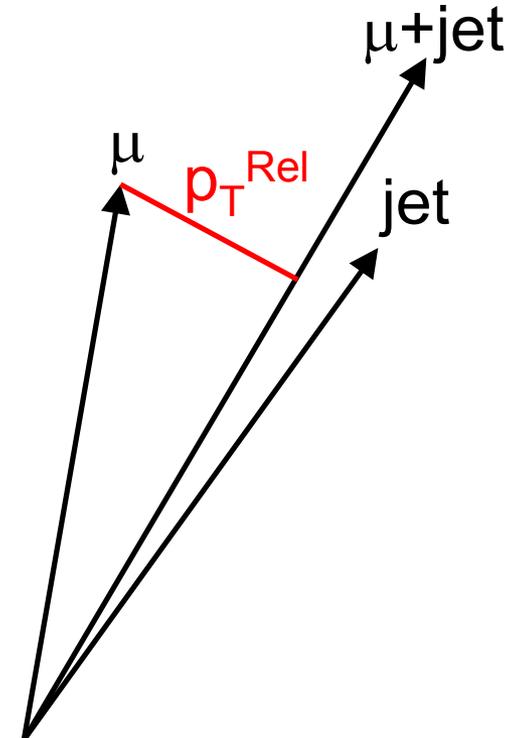
Data selection & kinematic cuts

$p_T^\mu > 6 \text{ GeV}/c$, $|\eta^\mu| < 0.8$ (Muon P_T measured in muon system only)

$|\eta^{\text{jet}}| < 0.6$, $E_t^{\text{corr}} > 20 \text{ GeV}$

0.5 cone

$\delta R(\text{jet}, \mu) < 0.7$

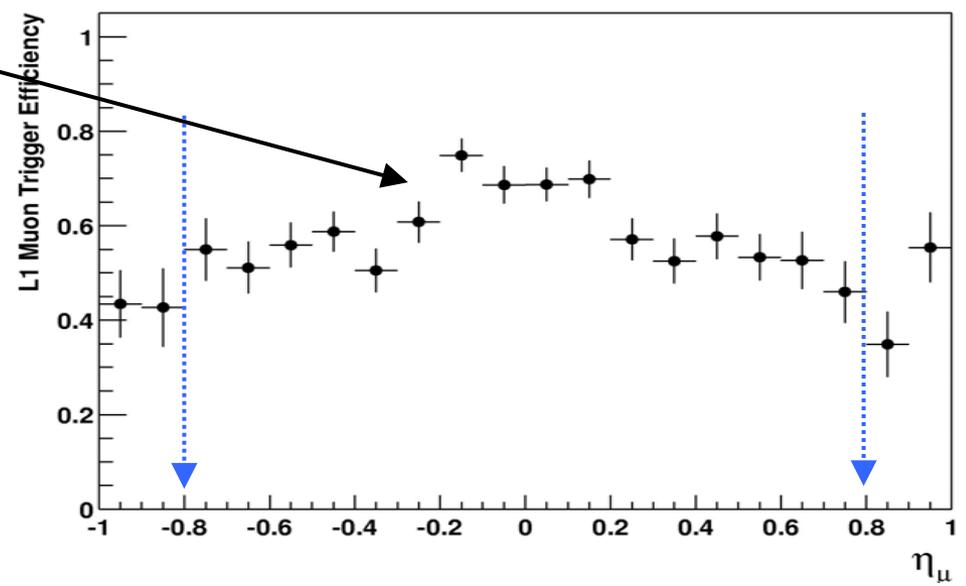




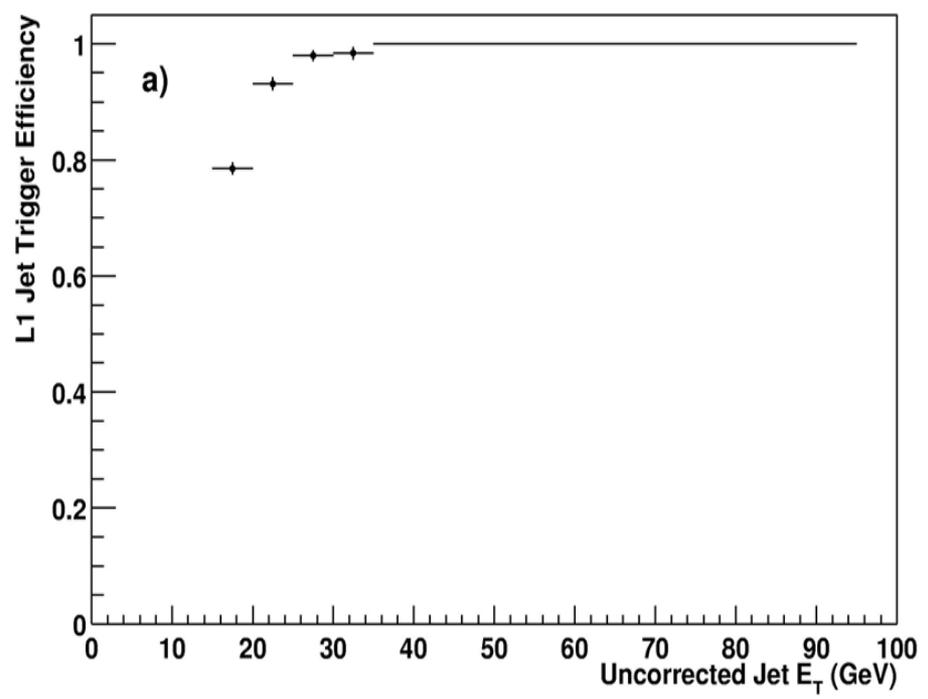
Muon + jet cross section

Lower in Jet E_T
so need muon and
jet trigger
efficiencies

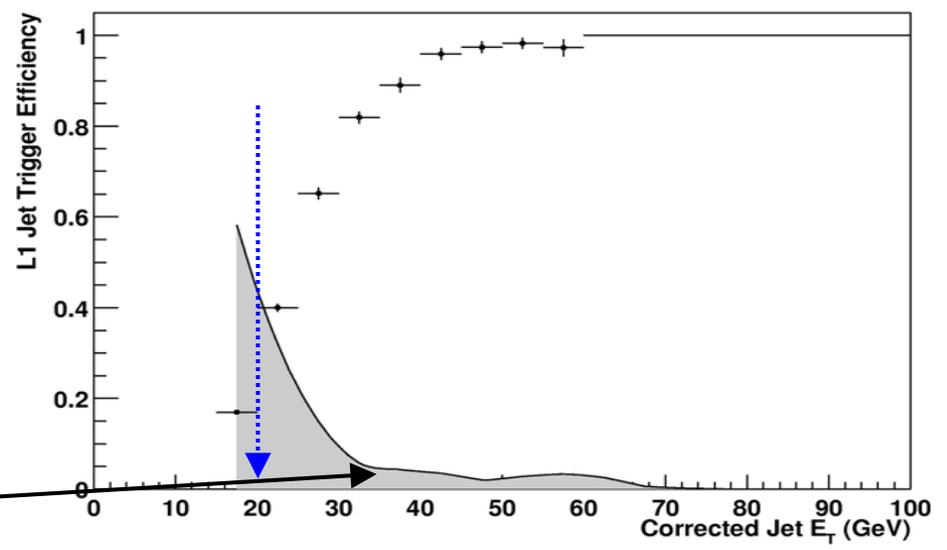
$\epsilon_{\text{muon}} = 55-70\%$



L1 Jet Trigger Efficiency, no JES correction



L1 Jet Trigger Efficiency, JES corrected



Error on Jet Energy scale



μ + jet cross section

Jet reco. Eff. 100% $E > 20$ GeV

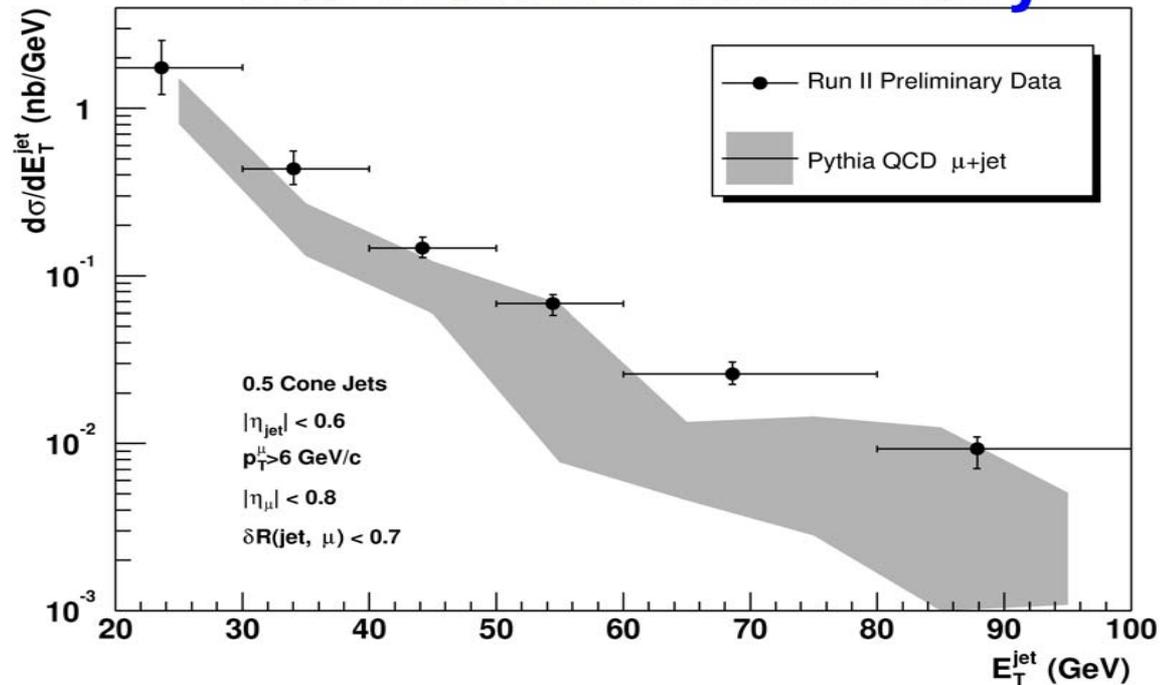
μ reco. Eff. $43.7 \pm 0.8(\text{stat}) \pm 2.2(\text{sys})\%$

Jet resolution: dijet p_T imbalance

μ momentum resolution: from central tracks

Jet quality cuts applied

DØ Run 2 Preliminary



Data: 02/27/02 – 05/10/02
 $\sim 3.4 \text{ pb}^{-1}$



B jet cross section



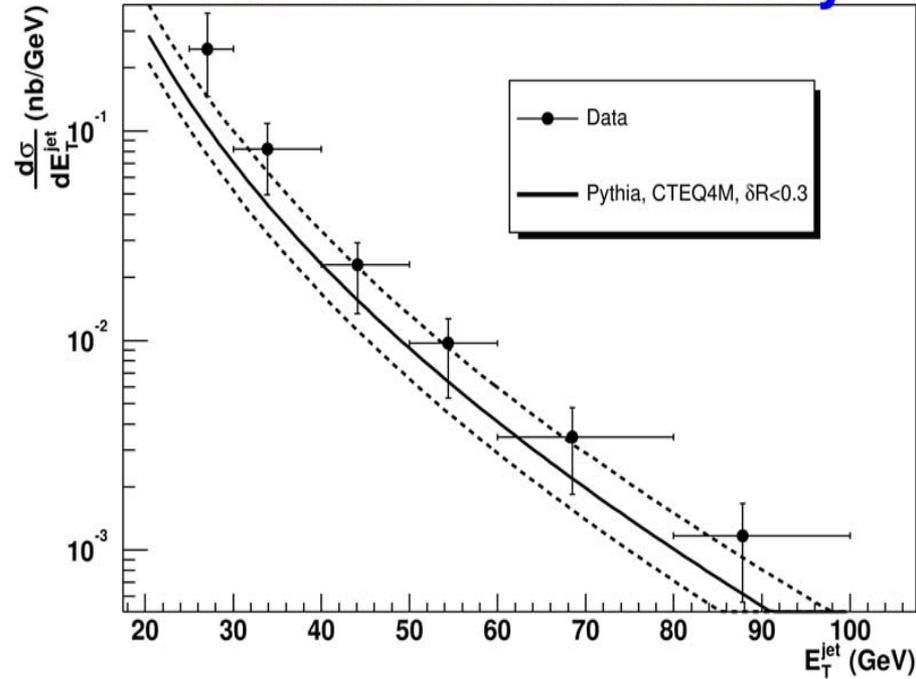
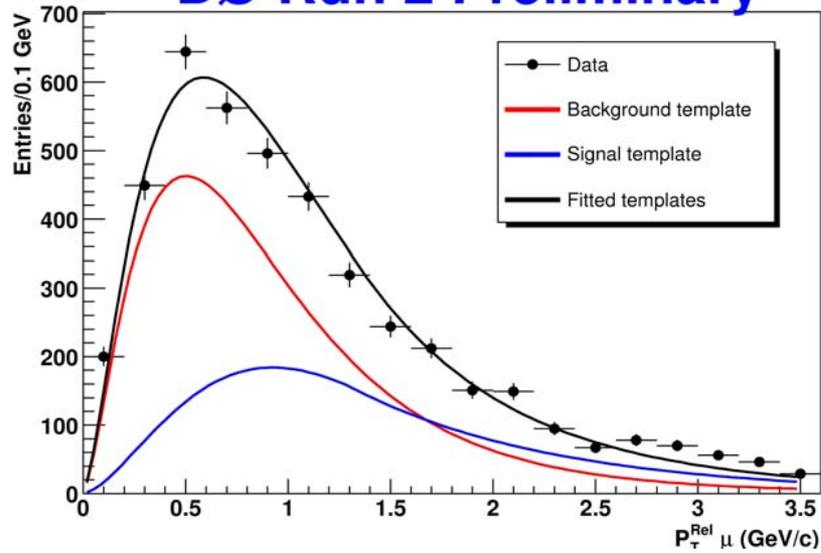
Fit p_{T}^{rel} templates to data in jet E_T bins

DØ Run 2 Preliminary

DØ Run 2 Preliminary

**p_{T}^{rel} for jets with
20 GeV < E_T < 25 GeV**

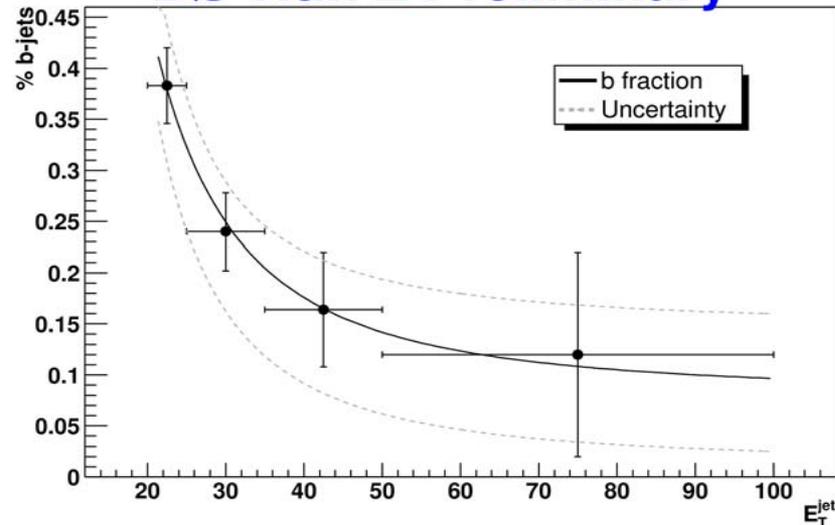
**B fraction as a
function of Jet E_T**



DØ Run 2 Preliminary

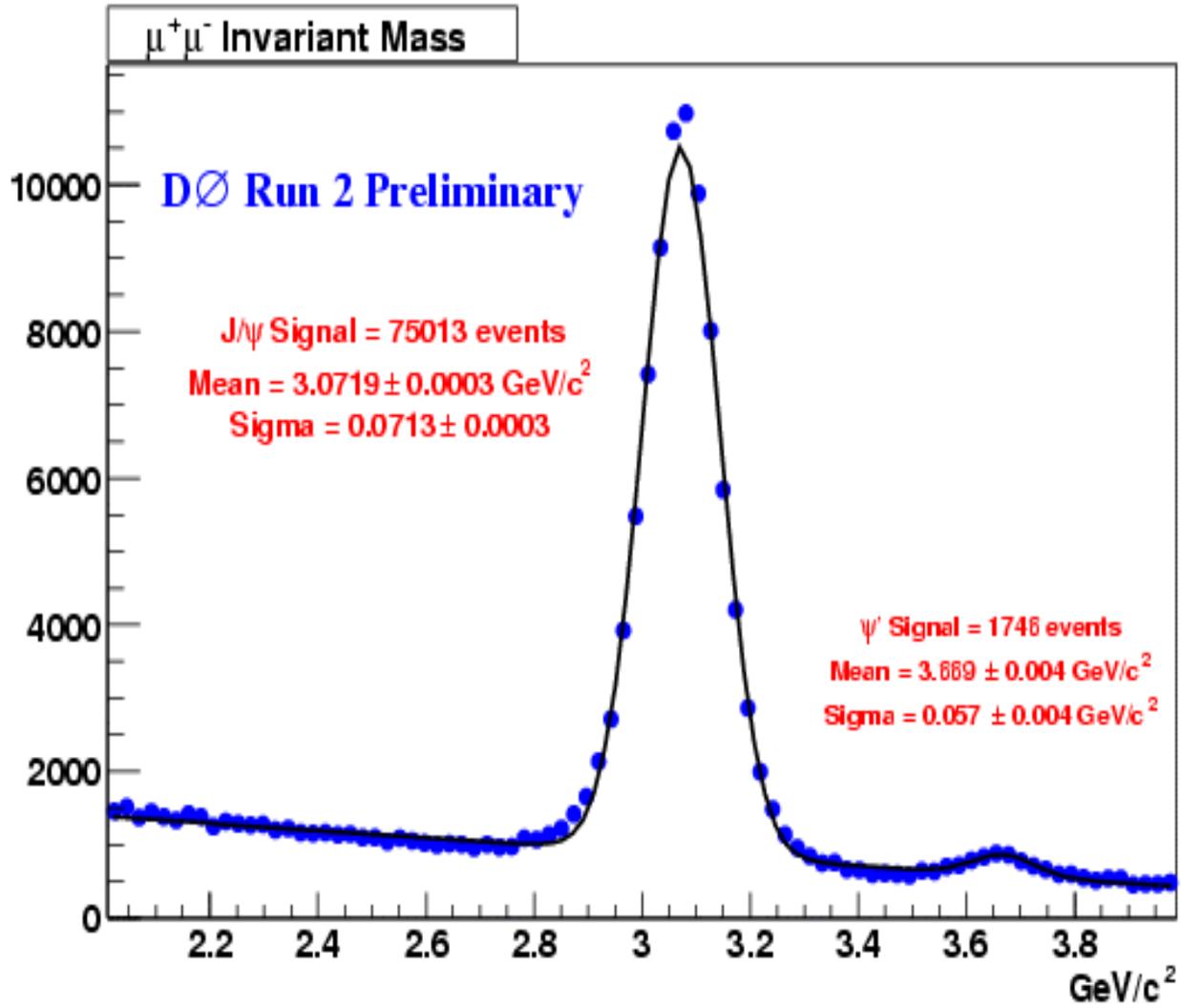
**Data unsmeared using
ansatz function**

**Dominant error is due to jet
energy scale**





The J/ψ



$\mu p_T > 1.5$ GeV &

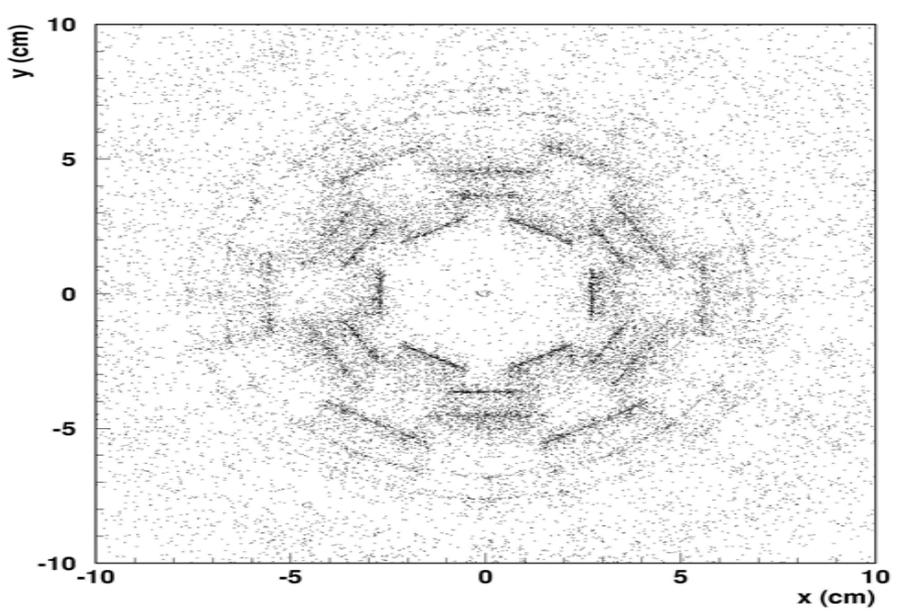
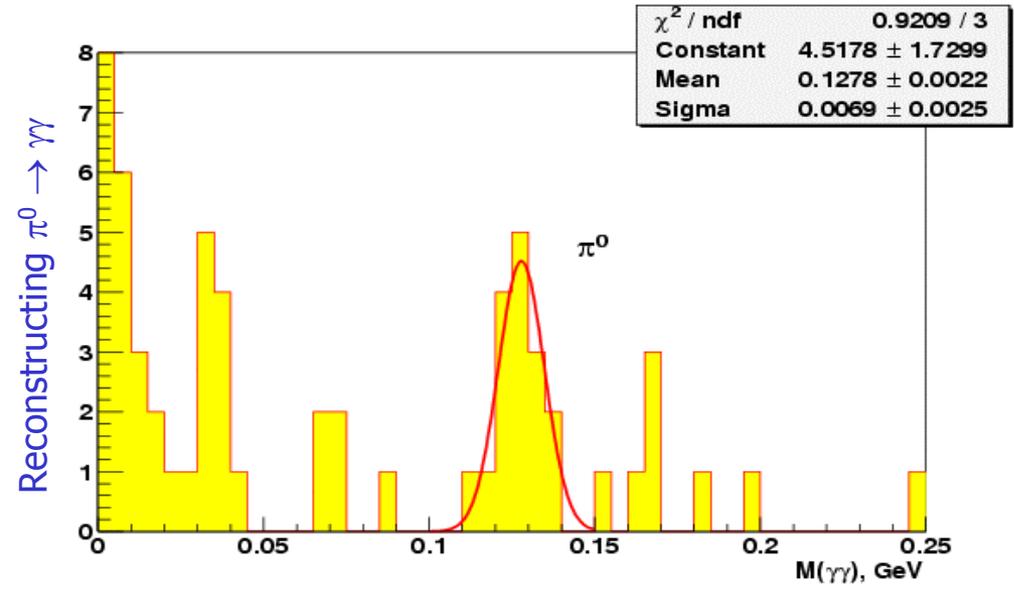
$J/\psi p_T > 3.0$ GeV

SMT hits > 3 & CFT hits > 4

J/ψ 's: 75,013

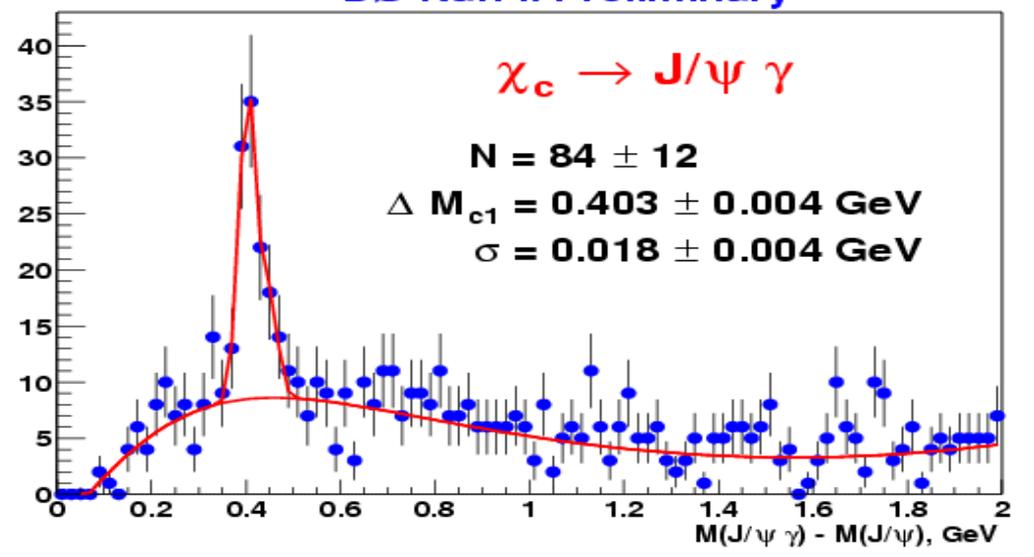


The J/ψ



DØ Run II Preliminary

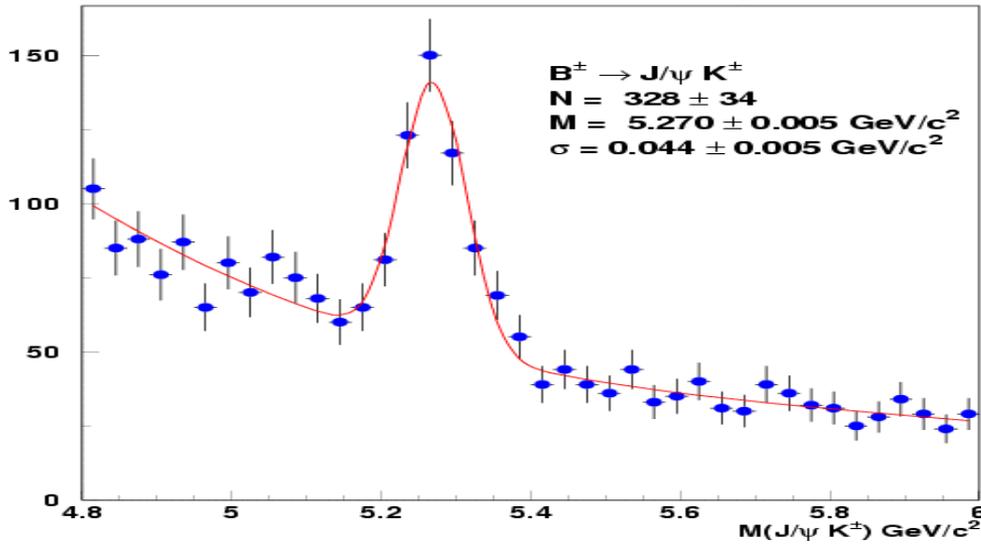
- $\gamma \rightarrow e^+e^-$ conversion
- J/ψ tracks $p_T > 2$ GeV
- γ tracks $p_T > 1$ GeV
- J/ψ mass window 2.8 – 3.3 GeV
- J/ψ and γ vertex constrained



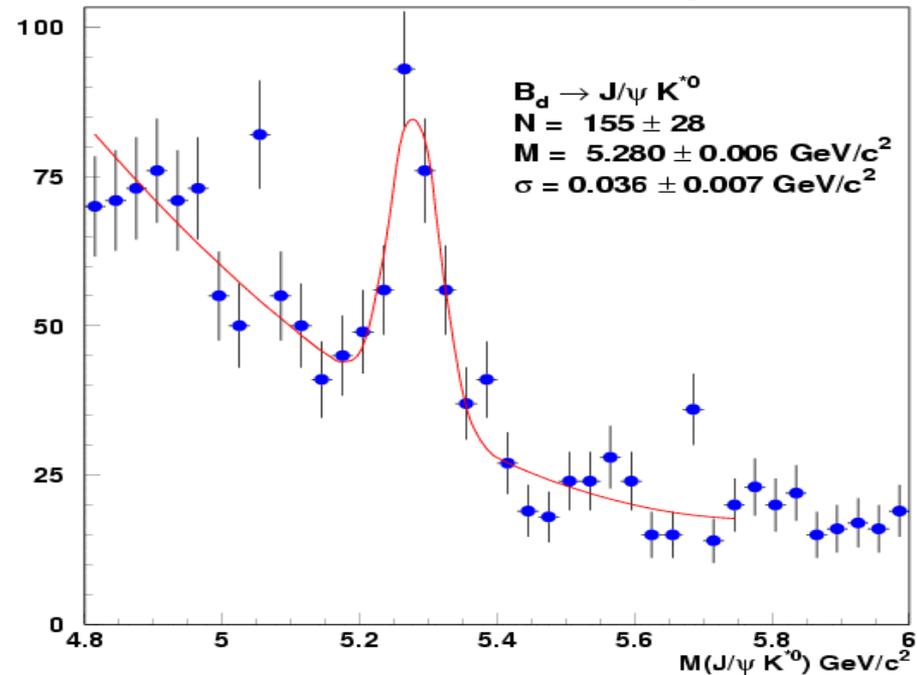


Exclusive B decays

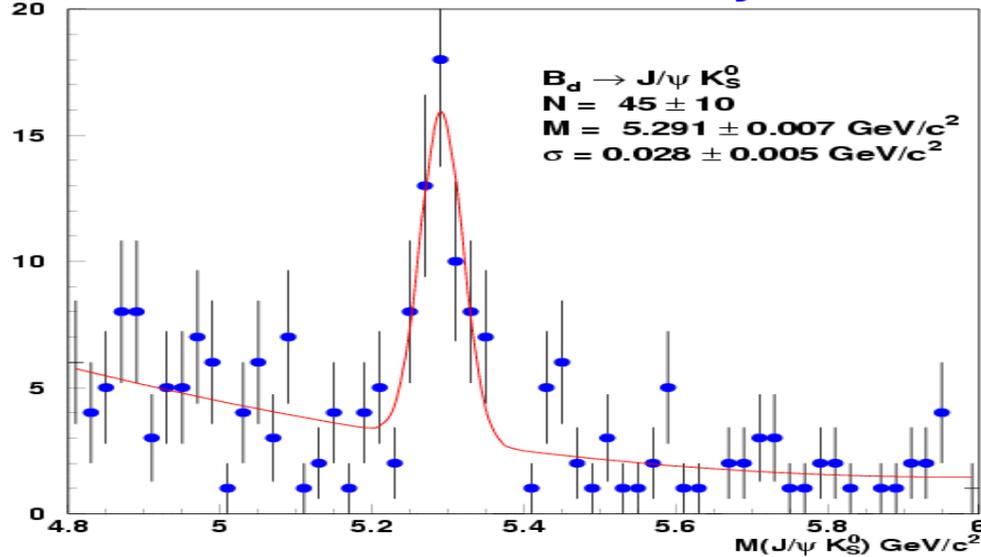
D0 RunII Preliminary



D0 RunII Preliminary



D0 RunII Preliminary





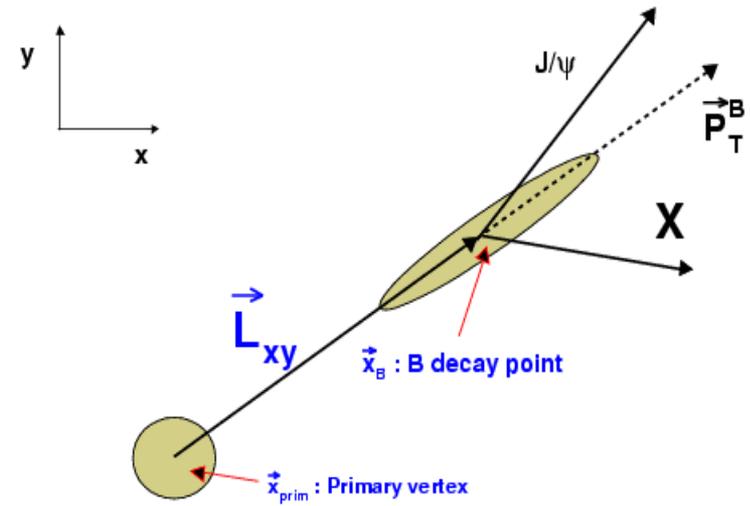
Average B Hadron Lifetime



J/ψ Sources { (c \bar{c}) states (prompt)
B → J/ψ

Difference { Prompt ~ PV
J/ψ(B) ~ SV

decay



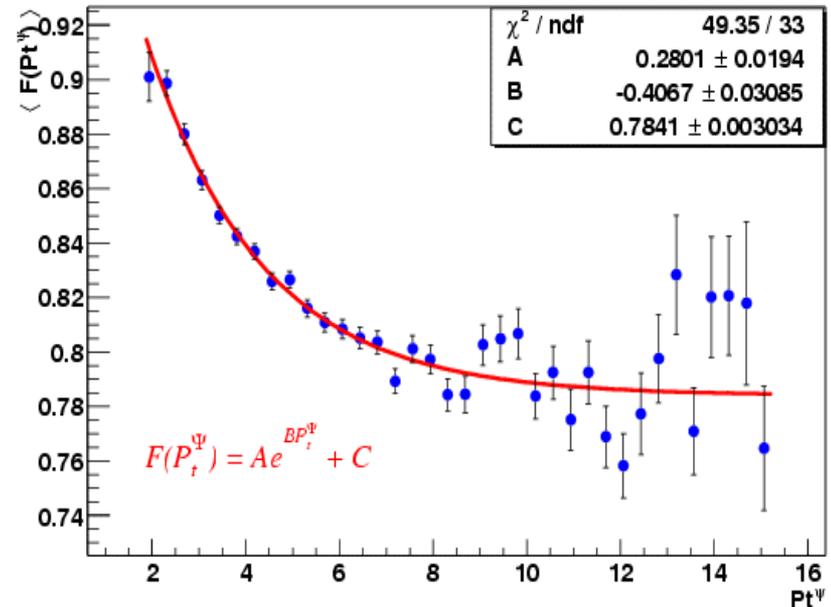
Transverse Decay Length Plot

λ_B through λ_ψ

$$\lambda_B = L_{xy} \frac{M^\Psi}{P_T^\Psi \langle F(P_T^\Psi) \rangle}$$

MC

$$\langle F(P_T^\Psi) \rangle = \frac{M_\Psi}{M_B} \frac{P_T^B}{P_T^\Psi}$$



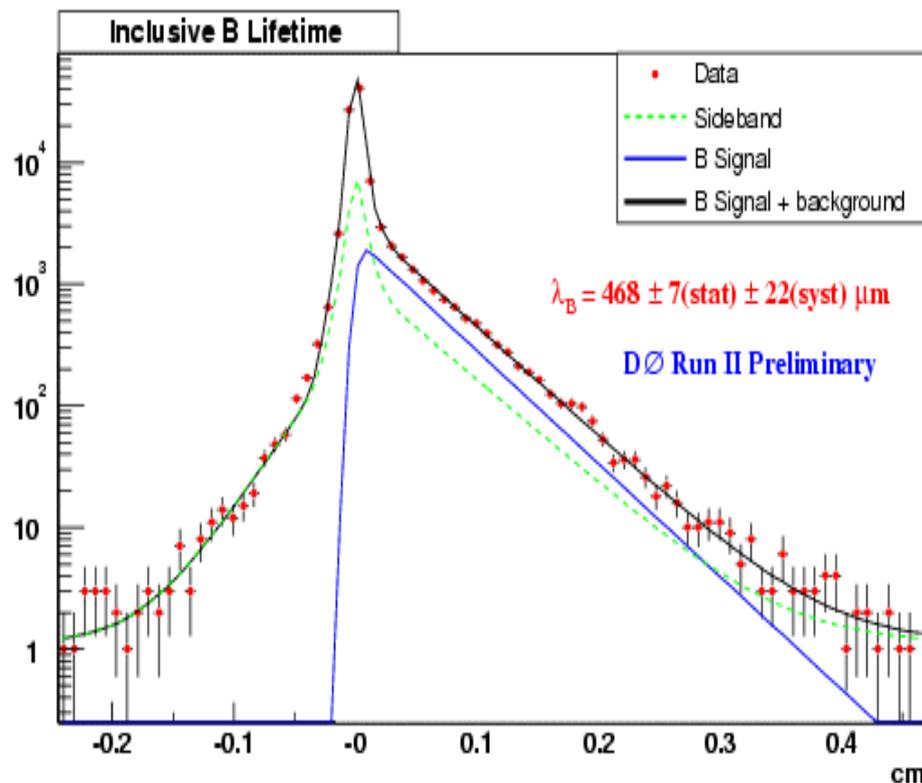


Average B Hadron Lifetime



Transverse Decay Length Plot Contributions

- **Zero lifetime component:**
 - Prompt J/ψ signal
 - Combinatorial Background
 - Both modeled as double Gaussians
 - Parameters from J/ψ sidebands
 - Background fraction from fit to J/ψ peak
- **Long lived component:**
 - $B \rightarrow J/\psi$ signal
 - Semileptonic Background
 - Both modeled as exponentials convoluted with gaussians
 - Background parameters and normalization determined from J/ψ sideband
 - Signal parameters floated



$\lambda_B = 468 \pm 7(\text{stat}) \pm 22(\text{syst}) \mu\text{m}$
B fraction: $17.3 \pm 0.5\%$
Prompt fraction: $82.7 \pm 0.6\%$
 $(\tau) = 1.561 \pm 0.024(\text{stat}) \pm 0.074(\text{syst}) \text{ ps}$

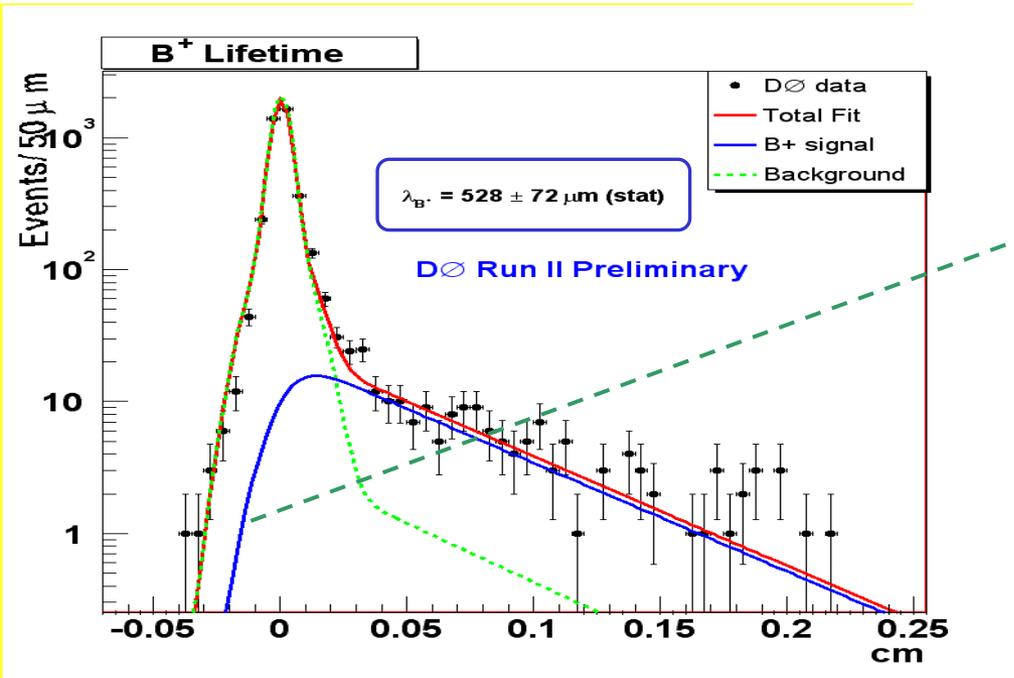
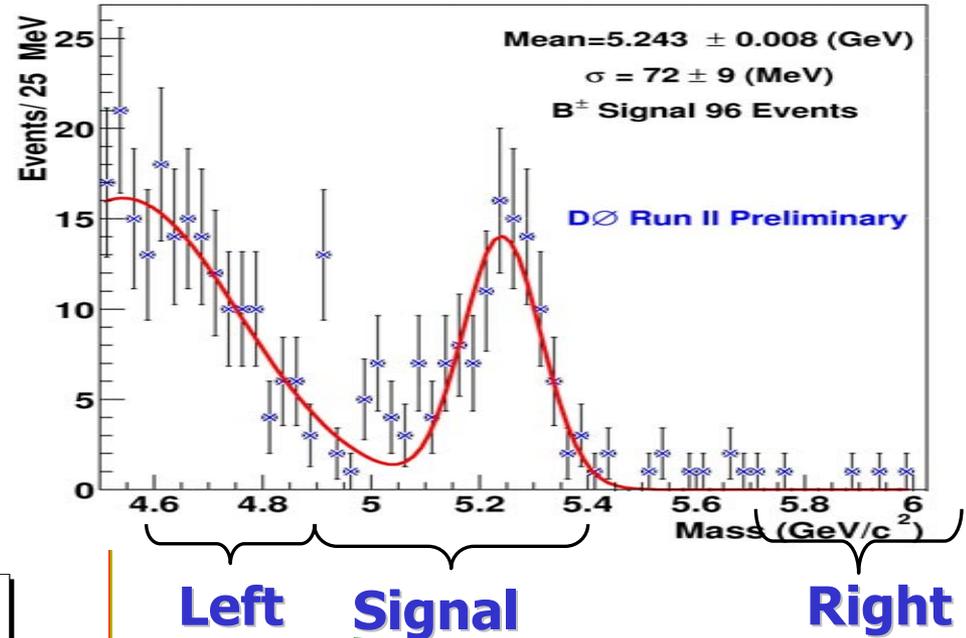


Charged B Lifetime



$$\lambda_B = L_{xy} \frac{M^B}{P_T^B}$$

- **R:** $G_1 \oplus G_2$
- **L:** Right $\oplus E^*G$ ($B \rightarrow J/\psi K^{0*}$)
- **P:** Right $\oplus E_1^*G_1 \oplus E_2^*G_2$





Flavor tagging



Jet Charge Tagging

Jet charge tagger:

- Remove daughter tracks from the reconstructed B
- Remove tracks 2D impact parameter greater than 0.2cm
- Remove tracks with $|vtx_z - pvtxz| > 2. \text{ Cm}$, suppress minimum bias events
- Use tracks left to calculate the jet charge Q by weighing on track p_T
- Events with $|Q| > 0.2$ are counted as tagged, while the others are dropped

Soft Muon Tag

Muon tagger:

- must have $\Delta R > 2.0$ separation from reconstructed B
- must have $p_T > 1.9 \text{ GeV}/c$
- **b flavor tagging:**
charge of highest- p_T muon in event gives (opposite-side) B -tag

$$\text{Efficiency } \varepsilon = \frac{N_{\text{correct}} + N_{\text{wrong}}}{N_{\text{correct}} + N_{\text{wrong}} + N_{\text{no tag}}}$$

$$\text{Dilution } D = \frac{N_{\text{correct}} - N_{\text{wrong}}}{N_{\text{correct}} + N_{\text{wrong}}}$$

$$\text{Tagging power : } \varepsilon \times D^2$$



B Flavor Tagging

DØ Run-II Preliminary

Soft muons

# of events	218
# of events with correct tag	13
# of events with wrong tag	5
Raw efficiency (%)	8.3±1.9
Raw dilution (%)	44.4±21.1
Estimated # of signal events	12.8
Estimated # of bgd events	5.2
Estimated efficiency of signal events (%)	8.2±2.2
Estimated dilution of signal events (%)	63.9±30.1
Estimated $\epsilon \times D^2$ of signal events (%)	3.3±1.8

Average jet charge

# of events	181
# of events with correct tag	66
# of events with wrong tag	48
Raw efficiency (%)	63.0±3.6
Raw dilution (%)	15.8±8.3
Estimated # of signal events	114
Purity	63.0
Estimated efficiency of signal events (%)	55.1±4.1
Estimated dilution of signal events (%)	21.0±10.6
Estimated $\epsilon \times D^2$ of signal events (%)	2.4±1.7

- Errors only statistical
- Errors in fractions of signal, bgd events in mass window (from fit) are ignored



Conclusions

- **Latest Run IIa DØ B Physics results**
 - B-jet cross section
 - B exclusive decays (B+, B0d in two different channels)
 - Average B Lifetime
 - Preliminary Charged B lifetime measurement
 - Understanding Flavor Tagging
- **Improvements in the short term future:**
 - Track trigger and Silicon Trigger

Just the beginning of an exciting DØ B Physics program ...



Average B Hadron Lifetime



Systematic Uncertainties

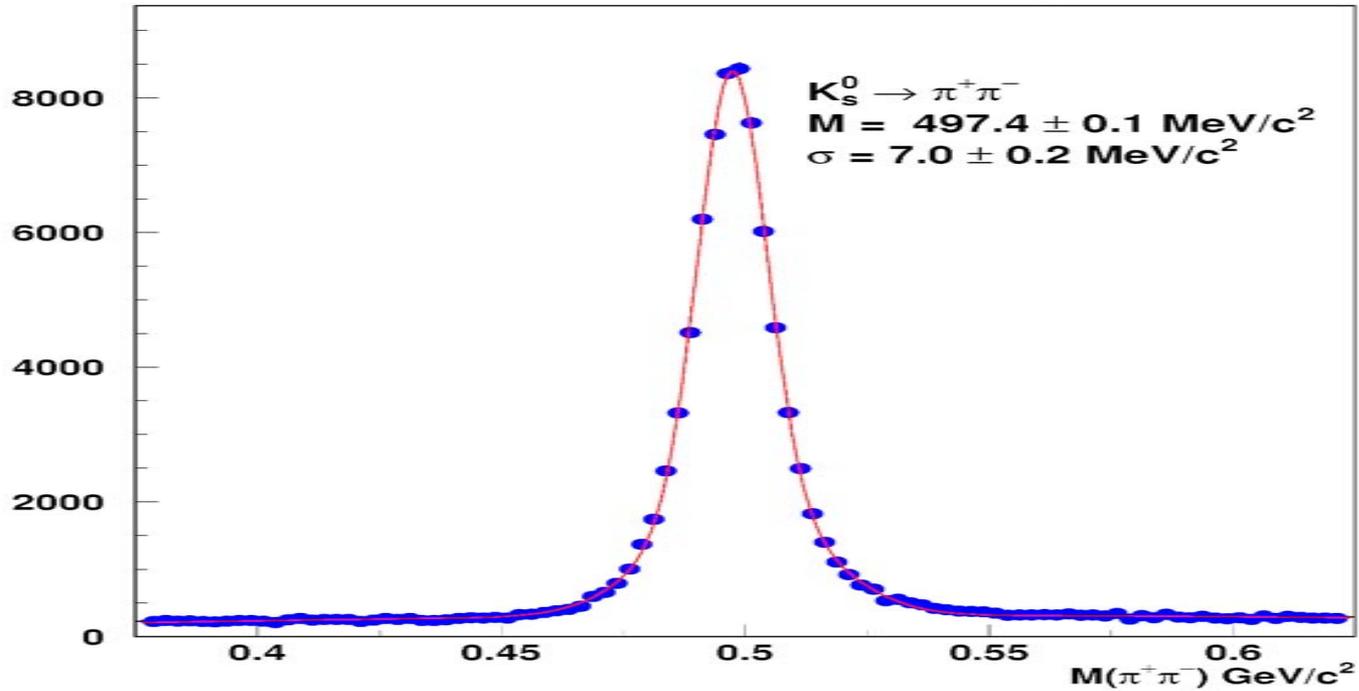
Source	Uncertainty (μm)
Boost Correction	± 15.9
Background Shape	± 3.0
Flight Length dependence	± 1.1
Back. Normalization	± 0.68
Alignment bias	± 4.1
Fitting Bias	± 13
Total	$\pm 22 \mu\text{m}$



V0 Finding



D0 RunII Preliminary





Flavor tagging

